

NATIONAL SECURITY

Lawrence Livermore National Laboratory was established in 1952 to help ensure national security through the design, development, and stewardship of nuclear weapons. National security continues to be the Laboratory's defining responsibility.

Threats to national security and global interests keep the United States actively engaged in world events at the beginning of the 21st century. The U.S. is committed to halting the spread of nuclear as well as chemical and biological weapons worldwide while maintaining sufficient nuclear forces to deter any adversary. Lawrence Livermore National Laboratory contributes to these important endeavors.

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Providing for National Security in a Changing World

A Part of the NNSA

Livermore is one of the three national security laboratories that are part of the National Nuclear Security Administration (NNSA), which began

operation within DOE in March 2000. With General John A. Gordon serving as its first administrator, NNSA brings together DOE's national security functions, a clear mission, and unique responsibilities.

Safe and Reliable Nuclear Weapons

Livermore plays a prominent role in the Stockpile Stewardship Program for maintaining the safety and reliability of the nation's nuclear weapons in the absence of nuclear testing. Working with the other NNSA laboratories, we are

attending to the immediate needs of the stockpile through assessments and actions based on a combination of laboratory experiments and computer simulations of nuclear weapon performance. We are also acquiring more powerful experimental and computational tools to address the more challenging issues that will arise as the nation's nuclear weapons stockpile continues to age.

Proliferation Prevention and Arms Control

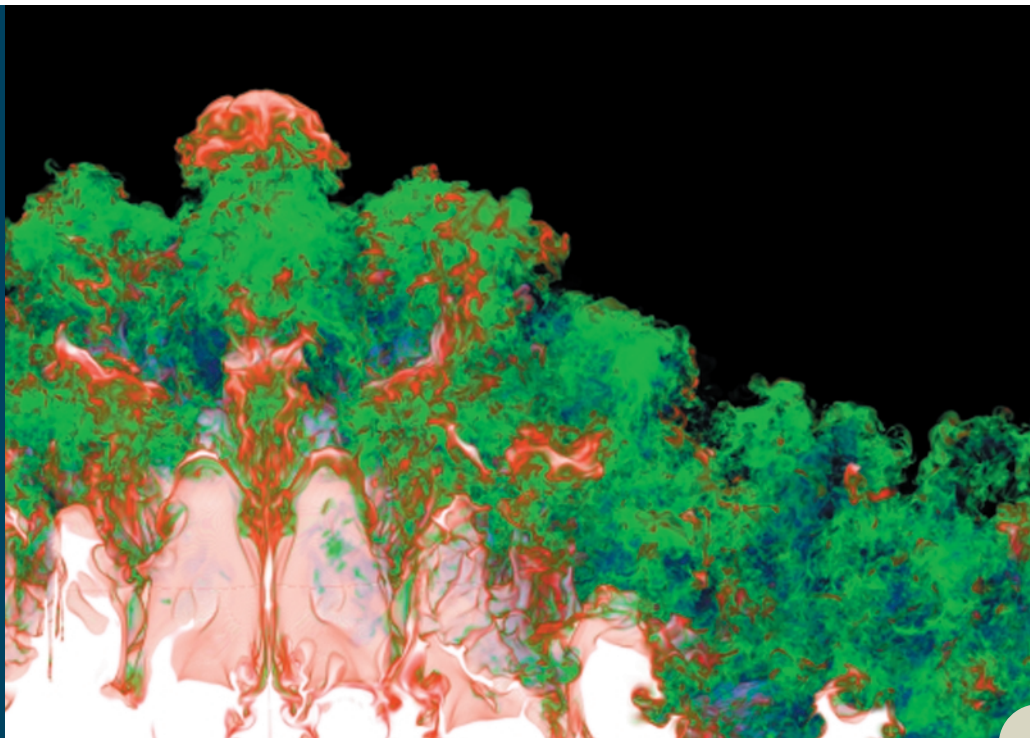
The Laboratory is addressing the dangers posed by the proliferation of



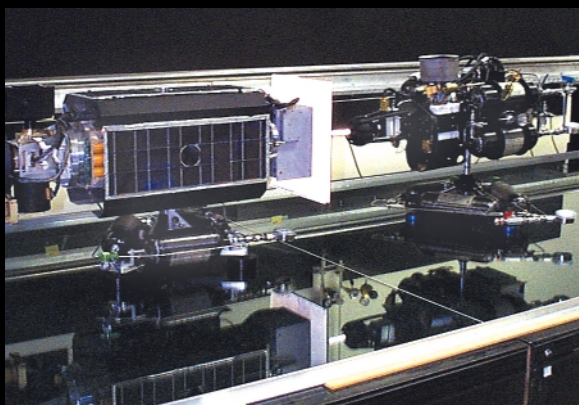
Congressional interest in stockpile stewardship remains high. The establishment of the NNSA, workforce quality and diversity, and the rebaselining of the National Ignition Facility (NIF) were priority issues for Representative Ellen Tauscher (10th District, California), a frequent visitor to the Laboratory. She and Representative Mac Thornberry (center, 13th District, Texas), both members of the House Armed Services Committee, met with Director Bruce Tarter and toured NIF (right photo) in December 1999.



High-resolution, three-dimensional (3D) scientific simulations using Accelerated Strategic Computing Initiative (ASCI) supercomputers are central to stockpile stewardship. An 8-billion-zone simulation recently revealed fine-scale physics of turbulence never seen before. The calculation generated more than 2 terabytes (2 million megabytes) of graphics data in more than 300,000 files.



nuclear as well as chemical and biological weapons through a wide spectrum of analysis and technology development activities. In addition, Livermore provides the government with technical information and assistance to support the development of national policy on nuclear weapons, nonproliferation, and arms control.



An engineering test vehicle (ETV) at Livermore demonstrates critical capabilities that future microsatellites will need to perform complex autonomous operations in the proximity of other space objects. With its novel object-tracking system and miniaturized propellant system, the ETV has repeatedly succeeded in docking with another object in dynamic experiments on an air table that simulates zero-gravity conditions.

Technology for New Security Requirements

Building on the scientific and technical capabilities needed for the Laboratory's stockpile stewardship and nonproliferation missions, Livermore develops advanced defense technologies for the Department of Defense (DoD) and other sponsors to increase the effectiveness of U.S. military forces and meet emerging national security needs.



A technician trained in handling fissile material inspects a plutonium part for an experiment at Livermore's plutonium facility. The Laboratory supports the Stockpile Stewardship Program through basic research on the properties of plutonium and surveillance of pits from Livermore-designed weapons. In leading the national plutonium immobilization program, we have developed and demonstrated hardware alternatives for plutonium storage.

As a principal participant in the nation's Stockpile Stewardship Program, Livermore is committed to maintaining confidence in the safety and reliability of the U.S. nuclear weapons stockpile. The program is extraordinarily demanding because the nuclear weapons in the stockpile continue to grow older, and we are challenged to ensure their performance and refurbish them as necessary without conducting nuclear tests.

The Stockpile Stewardship Program integrates the activities of the U.S. nuclear weapons complex, which includes Livermore, Los Alamos, and Sandia national laboratories as well as the four production sites and the Nevada Test Site.



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Stockpile Stewardship— Attending to Stockpile Needs



The Laboratory's activities involve weapons systems in all three legs of the U.S. strategic triad. We are completing the Life Extension Program for the W87 ICBM warhead; we are the design laboratory for the B83 bomb; we are beginning life-extension work on the W80 cruise missile warhead; and we are an integral part of the SLBM Protection Program.

Certifying Stockpile Safety and Reliability

In April 2000, the Secretaries of Energy and Defense certified to the President that the U.S. nuclear stockpile is safe and reliable and that no nuclear tests are needed at this time. This formal annual certification, which was the fourth since the inception of the Stockpile Stewardship Program, was based on technical reviews and independent evaluations conducted by Livermore, Los Alamos, and Sandia national laboratories. It is our responsibility to provide the President with accurate assessments of the safety, reliability, and performance of each weapon system in the nation's nuclear stockpile.

Final Certification of W87 Nears Completion

Livermore's W87 Life Extension Program, begun in late 1994, met all its major milestones. Refurbished W87s are being delivered to the Air Force after assembly

at the Pantex Plant. Refurbishment of the W87 ICBM warhead (the design with the most modern safety features in the stockpile) extends the lifetime of the weapon to beyond 2025.

The Laboratory's activities are directed toward final certification of the restocked weapons, which is expected in 2001. In summer 2000, we finished a final set of ground tests. We also flight-tested production verification units aboard a Peacekeeper missile launched in March 2000. No additional nuclear testing of the W87 is required to assure system reliability. Assessment of nuclear performance and subsequent certification are based on computer simulation, past nuclear tests, and new aboveground experiments that address specific physics issues.

Growing Stockpile Responsibilities

Lawrence Livermore and Sandia Livermore are assuming responsibility for the W80 Life Extension



With construction completed, the Contained Firing Facility at Site 300 (left) is undergoing qualification testing to assure the facility's ability to contain debris from hydrodynamic tests of mock weapon primaries. With the flash x-ray machine (right) taking multiple images during each experiment, the facility is designed to conduct tests that use up to 60 kilograms of high explosives.



Program. The W80, designed by Los Alamos, is deployed in air-launched and sea-launched cruise missiles. Plans for this life-extension program will draw on the results of a W80 Dual Baseline study, an in-depth assessment of refurbishment options to be completed by Livermore, Los Alamos, and Sandia in FY 2001. The schedule calls for the first production unit of the refurbished warheads in FY 2006. As refurbished W80 units enter the stockpile, Livermore will be responsible for continuing evaluations of their performance. Los Alamos will retain this responsibility for W80s not yet refurbished.

In addition, pits from Livermore-designed weapons will now be thoroughly examined at facilities for handling special nuclear materials in Livermore's Superblock. These stockpile surveillance activities previously had been conducted at Los Alamos.

Reassignment of responsibilities for the W80 and pit surveillance better balances activities at the two laboratories to maintain the

performance of stockpiled weapons. These new activities supplement the W87 Life Extension Program and our work with the U.S. Navy on an SLBM Warhead Protection Program. That program, now nearing completion, has been a five-year development effort by the NNSA laboratories to examine warhead pit reuse to meet the Navy's future warhead needs. Activities have included analyses, extensive ground testing, and a high-fidelity flight test conducted in April 2000 to measure flight dynamics.

Independent Reviews of Weapon Systems

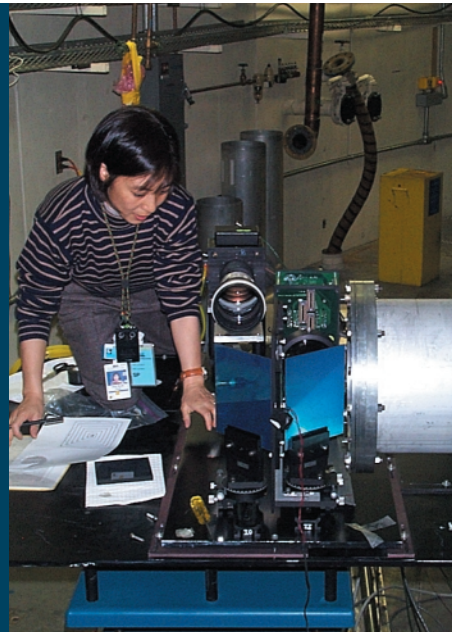
With publication of Livermore's W76 Dual Revalidation Report in April 2000, the Laboratory completed its responsibilities in a four-year-long reevaluation of the W76 SLBM warhead. The dual revalidation consisted of assessments by Los Alamos, which designed the warhead, and Livermore, which pursued extensive experimental and computational work to evaluate W76 performance.

In the absence of nuclear testing, the nation increasingly must rely on independent assessments by the NNSA laboratories—whose expert judgment is supported by computational models and experimental tools—to ensure the safety and reliability of weapons in the stockpile.



At Livermore's Hardened Engineering Test Building, specialists from the two laboratories prepare a drop test to validate the shock load performance of the Los Alamos-designed B61 earth-penetrator bomb.

Decisions and actions about the stockpile must be grounded in experimental reality. In the past, that reality included nuclear testing. Now, we ensure stockpile performance using laboratory experiments and computer modeling to achieve a much more sophisticated understanding of the underlying physics and engineering issues.



A Livermore physicist checks an imaging station and Laboratory-designed detectors at the end of the proton beamline at the Los Alamos Neutron Science Center. Together with Los Alamos scientists, we are exploring the possibility of using protons instead of x rays to create radiographic images for studies of nuclear weapons.

Stockpile Stewardship— Modeling and Experiments

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At Livermore, this two-stage gas gun accelerates projectiles to speeds of 8 kilometers per second to produce in a target a shock wave that is millions of times atmospheric pressure. We are bringing the Joint Actinide Shock Physics Experimental Research (JASPER) Facility into operation at the Nevada Test Site. With JASPER, researchers will perform important gas-gun experiments using uranium and plutonium targets.

Subcritical Experiments Study Plutonium

We successfully completed six of the eight planned subcritical experiments that compose the Oboe series, including four tests in 2000. Conducted in an underground tunnel at the Nevada Test Site, these highly instrumented experiments provide data on the behavior of plutonium when it is strongly shocked and how that behavior differs depending on the plutonium's age. These tests, which complement

simulations and laboratory experiments, help us understand how aging-related changes in plutonium affect the performance of stockpiled weapons.

Because we want to achieve test conditions, high explosives are detonated next to samples of plutonium. No critical mass is formed in the process, so no nuclear fission chain reaction occurs as it would in a nuclear detonation. Tests are instrumented with high-speed diagnostics, including a laser-based system that obtains holographic images of plutonium ejecta flying out from the shocked surface at the moment of explosion. The film images, when projected with a laser, allow experimenters to see in 3D a cloud of plutonium and analyze the size, shape, and velocity of the particles.

The Oboe tests are the first to be performed inside individual confinement vessels. Personnel enter the

underground test chamber to retrieve films and data after the test, once the chamber is determined to be free of contamination. The use of vessels for subcritical experiments is significantly reducing costs. Previously, each subcritical experiment took a minimum of one year to field and rendered unusable all diagnostic equipment in the test chamber.

A Better Model of High- Explosive Detonation

By linking two previously separate physics models, Livermore scientists now have a much better capability to simulate the detonation of high explosives. One of the codes, CHEETAH, models the chemical kinetics and thermodynamics involved in a detonation. Developed at the Laboratory with support from both DOE and DoD, CHEETAH is widely used within the defense community to evaluate new high explosives. CHEETAH is





Equipment typically used for making subway tunnels (left) carves out Livermore's underground test facilities. In a finished alcove (right), Livermore and Bechtel Nevada workers lower a package of plutonium and explosives into the heavily instrumented containment vessel for an Oboe subcritical experiment.

linked to the ARES hydrodynamics code. In the resultant simulation, as ARES determines the motion of the materials, CHEETAH provides at each time step the state of chemical reactions and equation-of-state data for the relevant intermediate and reaction products, which affect subsequent hydrodynamic performance.

Better data increase the accuracy of the simulation models. Experiments are being performed to obtain improved equation-of-state data for the materials—such as carbon dioxide—produced by high-explosives detonation. Researchers used Livermore's diamond anvil cell to study carbon dioxide at extreme conditions and, in the process, created two forms of solid carbon dioxide never seen before in the laboratory.

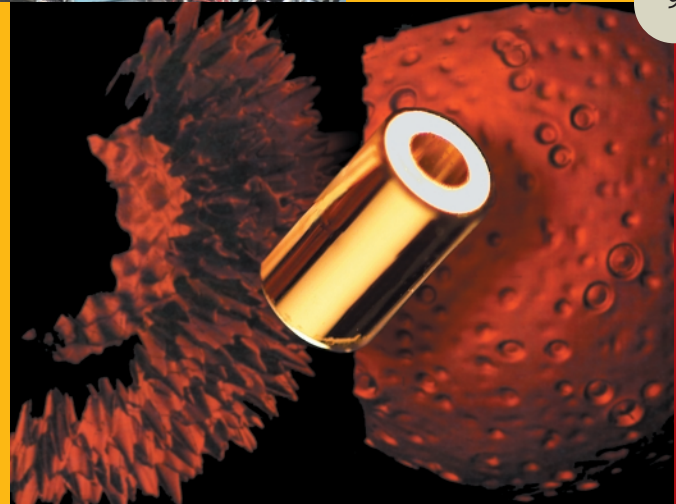
3D Weapons Physics Simulations

Increasingly sophisticated 3D simulations of weapons

physics are being made possible by successively more powerful computers, which have been installed at the Laboratory as part of the DOE's Accelerated Strategic Computing Initiative. Three-dimensional simulation is critically important: nuclear explosion phenomena are seldom symmetric because of aging and manufacturing variations.

Livermore researchers achieved a major milestone in the Stockpile Stewardship Program in late 1999 with the first-ever 3D simulation of a nuclear-weapon primary explosion. The next step in the full-system modeling of weapon performance is a 3D simulation of the thermonuclear burn of a weapon secondary. Such work is in progress using the ASCI White supercomputer.

In addition to the codes developed to simulate nuclear weapon performance, the Laboratory has developed the HYDRA code, which was used in 2000 to simulate in 3D the



performance of targets that might be used in the National Ignition Facility to achieve ignition and thermonuclear burn. The simulations were run on 1,680 processors of the Blue Pacific computer using a mesh of more than 16 million zones. HYDRA was also used to model the results of hydrodynamic instability experiments performed on the Laboratory's Nova laser and the University of Rochester's Omega laser.

In a 3D HYDRA simulation using over 16 million zones, we studied the growth of hydrodynamic instabilities due to surface roughness in a target capsule for the National Ignition Facility. Two surfaces of constant density (left) are shown prior to thermonuclear ignition; a contour of the rebounding shock at ignition time is on the right. A typical NIF capsule is shown in the foreground.

The greatest challenges in stockpile stewardship lie ahead, as weapons continue to age. Success depends on bringing into operation vastly improved scientific capabilities, which will be used by our experienced nuclear weapons designers to train the next generation of stockpile stewards, who will rely on the new tools. At Livermore, we are acquiring powerful supercomputers to better simulate weapons performance, and we are constructing the National Ignition Facility to perform needed thermonuclear physics experiments.



Stockpile Stewardship— Greater Capabilities to Come

In 28 tractor-trailer trucks from Poughkeepsie, New York, the IBM ASCI White supercomputer—the world's fastest and most powerful—was delivered to the Laboratory during summer 2000. The machine is powered by 8,192 IBM RS/6000 processors and covers an area the size of two basketball courts. ASCI White has enough memory to hold six times the entire book collection of the Library of Congress.

World's Most Powerful Computer

In summer 2000, Livermore became home to the world's most powerful supercomputer with the delivery from IBM of ASCI White, which is capable of performing over 12 trillion operations per second (12 teraops). The ASCI White machine was acquired through the Accelerated Strategic Computing Initiative (ASCI), a key component of the Stockpile Stewardship Program. ASCI is rapidly advancing the state of the art in computers, modeling

techniques, and data-management tools needed to simulate the performance of nuclear weapons.

ASCI White is based on the next-generation IBM processor, node, and switch technology. It has 512 nodes, each with 16 processors. Exceeding its contractual performance requirements, the machine is about three times faster than Livermore's Blue Pacific computer, which was used to perform the first-ever 3D simulation of an exploding nuclear weapon primary. About 100,000 times more powerful than a typical

desktop computer, ASCI White provides over 12 terabytes (trillion bytes) of main memory and over 147 terabytes of global disk space.

The advanced computing capabilities made possible by ASCI move us closer to the goal of performing full-scale simulations of weapons performance based on first-principles physics without resorting to simplified models. These new capabilities—on smaller, unclassified systems—offer future unprecedented levels of understanding in climate and weather modeling, environmental studies, the design of new materials, and many areas of physics.

NIF Plans Revised as Construction Continues

Construction continued at Livermore on the National Ignition Facility (NIF) as the NIF project team developed a rebaselined plan for finishing the project. The new baseline plan was validated and approved by DOE in September. It calls for laser operations to begin in FY 2004 and completion of the project in FY 2008.





Conventional construction for NIF is essentially completed, and installation of the laser beampath infrastructure is under way. The 118,000-kilogram target chamber, a 10-meter-diameter aluminum sphere, has been installed, leak-tested, and prepared for additional shielding. Mounted on the chamber's outer surface will be hundreds of diagnostic instruments and 48 final optics assemblies that will convert the laser pulses from infrared to ultraviolet and focus the light precisely on a target the size of a BB-gun pellet.

The NIF project was rebaselined to enhance the planned method of assembling and integrating the lasers and to ensure that strict beampath cleanliness requirements would be met. The NIF project team contracted with experts from industry to implement plans for installing laser components, and the team took steps to greatly improve project management.

In parallel, exceptional progress was made on many technical fronts. In September 2000, DOE's Energy Systems Acquisition Advisory Board approved the new NIF baseline, and the Secretary of Energy submitted his certification of the NIF project plans to Congress. The Secretary of Energy's Advisory Board (SEAB) also concluded that the corrective actions undertaken by the NIF project team together with the revised cost and schedule baseline in the Secretary's report to Congress are sufficient to permit the NIF project to be completed as planned.

Construction activities in 2000 bring the conventional facilities to 95 percent completion—both for the optics assembly building and

the stadium-size laser building with its laser and capacitor bays, laser-beam switchyards, and target bay. The NIF integration management and installation contractor is making great progress installing the enclosures for the laser beams and support systems. Over 1,000 tons of beampath infrastructure were in place by January 2001. The design of line-replaceable units—modular components that constitute the special laser, target, and optical equipment—is nearly complete, and more than 1,000 laser glass slabs meeting NIF specifications have been produced.

With the world's most powerful laser in NIF, many fundamental processes of thermonuclear ignition and burn soon will become accessible for laboratory study and analysis. By focusing its energy on a BB-size target for a few billionths of a second, NIF will generate in experiments the temperatures and pressures needed to validate weapons-physics computer codes and address important issues of stockpile stewardship.



The development of improved methods for manipulating and interpreting terabytes of data is an important focus of ASCI. Livermore researchers test the usefulness of new visualization tools—a novel desktop display and “data gloves” that allow the user to reach out and seemingly move and examine images.



Design is completed for the Terascale Simulation Facility, which will house Livermore's next supercomputer after ASCI White. The \$89-million facility will include a computer complex with about an acre of floorspace as well as office space for a growing staff of computer and physical scientists who support ASCI.

The proliferation of nuclear, chemical, and biological weapons, collectively referred to as weapons of mass destruction (WMD), is of grave concern to U.S. security. We are tackling the problem of proliferation across the entire spectrum of the threat, from preventing proliferation at the source, to detecting and reversing proliferant activities, to responding to the threatened or actual use of such weapons.



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Proliferation Prevention and Detection

Reducing the Russian Nuclear Threat

Since the early 1990s, the U.S. and Russia have engaged in a range of negotiations designed to reduce the danger from nuclear weapons. Issues have included shutting down plutonium-producing reactors, monitoring nuclear stockpiles, inspecting stored nuclear material, and disposing of excess plutonium. Many of these negotiations have floundered on the shoals of the classified information that would need to be exchanged in order to verify the agreements.

As a way out of this impasse, Livermore and Los Alamos developed the concept of an information

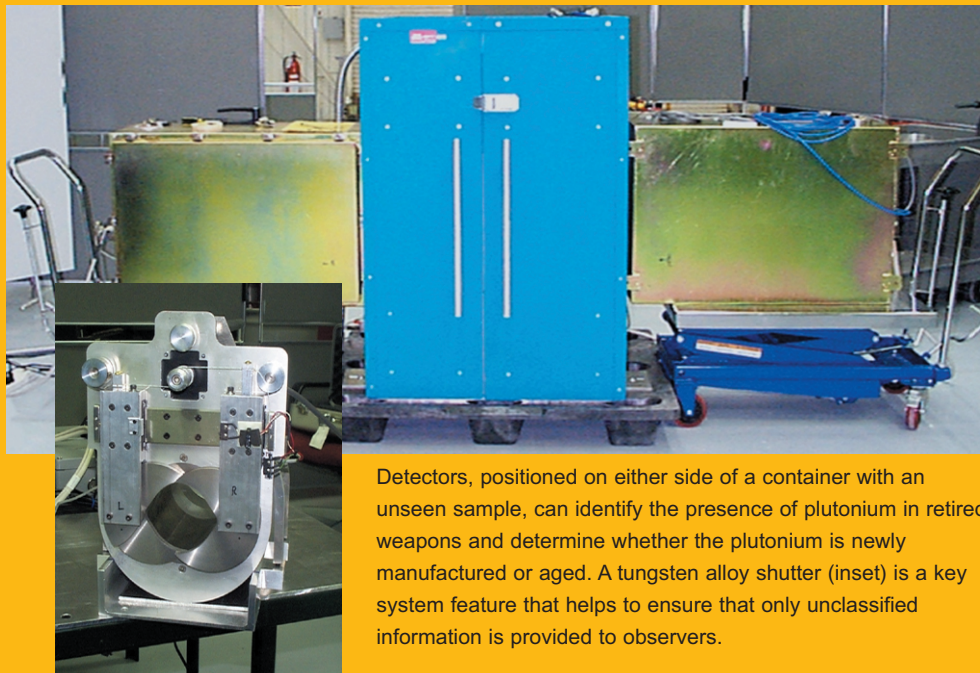
barrier—a set of hardware, software, and procedures—to allow measurements on classified objects but prevent classified information from being revealed to inspectors. We demonstrated such a system to Russian scientists and security specialists in August 2000 at Los Alamos. The Fissile Material Transparency Technology Demonstration consisted of measurements on a number of unclassified authentication sources as well as measurements on a weapon component. The extremely successful demonstration is enabling valuable headway on this difficult but essential treaty-monitoring issue of exchanging just the required information.

Through the DOE's Material Protection, Control, and Accounting (MPC&A) program, we are working to improve the security of Russia's weapons-usable nuclear materials. Livermore leads MPC&A project teams at Chelyabinsk-70, Sverdlovsk-44, the Bochvar Institute, and Krasnoyarsk-45. We are also working with the Northern and Pacific Fleets of the Russian Navy to enhance the protection of the nuclear fuel for their nuclear-powered vessels. This work involves direct interactions with the Russian Ministry of Defense, an activity that would have been inconceivable during the Cold War.

Livermore's Center for Global Security Research (CGSR) organized and hosted the After Globalization Conference attended by Vice Admiral Arthur Cebrowski (left photo, left foreground) and Former Secretary of State George Shultz (right foreground). CGSR Director Ronald Lehman (right photo, center) was a principal participant in the formal dedication of the Open Computing Center at Snezhinsk, Russia.



Livermore researchers examine the Russian-designed and -built plutonium oxide salt washer that is being tested for use in the U.S. plutonium disposition program. We are helping make nuclear materials more secure in the United States and worldwide.



Detectors, positioned on either side of a container with an unseen sample, can identify the presence of plutonium in retired weapons and determine whether the plutonium is newly manufactured or aged. A tungsten alloy shutter (inset) is a key system feature that helps to ensure that only unclassified information is provided to observers.

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Assisting Conversion at Russian Nuclear Complex

Downsizing the Russian nuclear complex is a high-priority U.S. national security goal. However, such downsizing will eliminate the jobs of thousands of Russian weapons workers. To accelerate the downsizing process, the U.S. and Russia have launched the Nuclear Cities Initiative to create self-sustaining civilian jobs for displaced workers in the closed nuclear cities of Sarov, Snezhinsk, and Zheleznogorsk.

Livermore leads the DOE team working with Snezhinsk and its various civilian entities to develop commercial enterprises. For example, we have a contract with SPECTR-Conversion to develop improved technologies for oil-well-casing perforators. In November 2000, the Strela Open Computing Center was dedicated. This center will facilitate the ability of Western firms to tap Snezhinsk's expertise in computer programming,

software development, and scientific computations for commercial applications.

We are also working with the Avangard Foundation (the commercial element of the Avangard Electro-mechanical Plant at Sarov) and Fresenius Medical Care AG (the world's largest provider of products and services for individuals with chronic kidney failure) to develop a manufacturing center at Sarov for dialysis machines and disposable products. Contracts were signed in March 2000, and fences were moved in June to enable work activities outside Avangard's high-security area. Several hundred former weapons workers will eventually be employed in this enterprise. This collaboration is a major milestone in U.S. efforts to engage a Russian weapons production facility.

Remote Sensing for Proliferation Detection

Chemicals associated with the various stages (research and development,

production, testing, storage, use) of weapons of mass destruction are released into the environment at levels that may be detectable by technical means. Remote detection of these chemical signatures would provide clues that, in conjunction with other sources of information, could be used to infer the nature of the activities that generated them. We are developing optical remote-sensing techniques for detecting, identifying, and quantifying signatures of the proliferation or use of weapons of mass destruction.

For example, we have developed a hyperspectral infrared imaging spectrometer (HIRIS) for passive remote sensing of chemical signatures. The system was flown in several successful challenging flight campaigns this past year. The data from these flights are being used to refine the HIRIS remote gas analysis software and models and to further validate the instrument's performance.

We leverage Laboratory capabilities to provide technology, analysis, and expertise for DOE and DoD in such areas as biodefense, counterproliferation analysis, missile defense, solid-state lasers, advanced conventional munitions, and energetic materials. We also work with the Justice, Treasury, and Commerce departments to improve the nation's ability to prevent and mitigate terrorist use of mass-destruction weapons.



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Response to Proliferation and Other Security Threats

Fast, Accurate, and Portable Biodetectors

Livermore is a major participant in DOE's Chemical and Biological National Security Program and has developed unique instruments that dramatically advance

biodetection capabilities. Our Handheld Advanced Nucleic Acid Analyzer (HANAA) was originally developed for use on the battlefield or in the event of a terrorist attack. It also has broader civilian health uses. It is the first truly portable DNA analysis instrument suitable for real-time identification of bioagents in the field.

Biode detectors require unique antibodies or DNA sequences to identify and characterize pathogens. We are developing a comprehensive array of such signatures to support a wide range of biological detection capabilities. We are working with the Centers for Disease Prevention and Control (CDC) to validate these signatures for use by the public health community. Collaborating with Los Alamos National Laboratory, we developed DNA signatures for *B. anthracis* (anthrax) and *Y. pestis* (plague) and transferred these to CDC for final multiagency validation.

We are now developing signatures for additional pathogens.

Technology to Support Military Operations

The Counterproliferation Analysis and Planning System (CAPS) enables users to analyze a proliferator's weapons production capabilities end to end and to assess interdiction options and corresponding consequences. Developed at Livermore, CAPS has been widely accepted by the defense community. In the Defense Planning Guidance for 2000, the Secretary of Defense named CAPS as the preferred counterproliferation tool to be used by the nation's armed services.

In August 2000, we used CAPS to provide crisis management support to naval operations in the Navy 3rd Fleet Limited Objective Experiment-Zero, held at sea and near Point Magu in southern California. This exercise demonstrated the full integration of the Atmospheric Release



Livermore's Atmospheric Release Advisory Capability's Emergency Operations Center mobilizes to model an atmospheric release. Models use real-time meteorological data to calculate the dispersal of released aerosols or particulate matter. We have integrated ARAC's capabilities into Livermore's CAPS and JTOPS programs to provide analytical support to emergency responders in the event of a chemical or biological attack.

Developing DNA signatures involves microbiologists, molecular biologists, biochemists, geneticists, and computer experts. Here, biomedical scientists work to distinguish DNA of various species of virulent organisms.

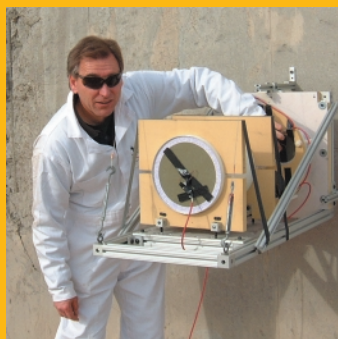


Advisory Capability (ARAC) into CAPS, whereby users can incorporate real-time meteorological and plume data for consequence analysis.

We are leveraging CAPS, hyperspectral imaging activities, and our entity-level combat simulation model (Joint Conflict and Tactical Simulation, or JCATS) to design the Joint Total Operational Planning System. JTOPS aims to provide military planners with a tool to integrate real-time critical intelligence into mission planning. Elements of the JTOPS concept were successfully tested in the Navy 6th Fleet Battle Experiment-Golf, held in Italy during March 2000. JCATS provided a virtual battlefield context for the exercise. Planners also used pre-scripted hyperspectral data to monitor operation of a hypothetical WMD facility and "reached back" to the Laboratory through CAPS to obtain technical information on selected targets and to evaluate the consequences of attacking selected areas.

Technologies for Air and Missile Defense

In support of the Army's Space and Missile Defense Command, the Laboratory is working with industrial partners to develop a 100-kilowatt (average power) solid-state laser to be deployed on a mobile battlefield platform. Such high-power laser systems are leading candidates for an enhanced air-defense capability. In 2000, we brought into operation a 10-kilowatt prototype laser and tested its effectiveness in damaging selected materials. This laser will be delivered to the High-Energy Laser Strategic Test Facility (HELSTF) at White Sands Missile Range in May 2001.



Also during 2001, we will begin work on a submodule of a 100-kilowatt diode-pumped laser that is to be delivered to HELSTF in 2003.

We are contributing to missile defense with the Remote Optical Characterization Sensor Suite (ROCSS). In experiments conducted in the High Explosive Applications Facility (HEAF), ROCSS successfully detected chemical seedant in a high-explosive environment such as would exist after a missile intercept. The goal is to provide battlefield commanders with a tool to determine if an intercepted hostile warhead was carrying chemical or biological agent.



The Laboratory's JCATS team won an award (also see p. 30) from DoD's Defense Modeling and Simulation Office for modeling conflict on scales ranging from a handful of fighters in an urban security operation to battles between units of thousands with tanks, aircraft, and submarines.

We are working with the DoD to improve the capability of low-velocity cruise missiles to penetrate hard targets. Our new multicharge precursor warhead consists of a cluster of small charges with a single large charge in the back. It is designed to efficiently create a large hole for the cruise missile to fly through virtually unimpeded (right).